

CLAIMS:

1. A method of establishing wireless communications between an interrogator and individual multiple wireless identification devices, the method comprising combining tree search and Aloha methods to establish communications between the interrogator and individual of multiple wireless identification devices.

2. A method in accordance with claim 1 wherein the combined Aloha methods are slotted Aloha methods.

3. A method in accordance with claim 1 wherein the wireless identification device comprises an integrated circuit including a receiver, a modulator, and a microprocessor in communication with the receiver and modulator.

1           4.    A method of addressing messages from an interrogator  
2 to a selected one or more of a number of communications devices,  
3 the method comprising:

4           establishing a first predetermined number of bits to be used  
5 as unique identification numbers, and establishing for respective  
6 devices unique identification numbers respectively having the first  
7 predetermined number of bits;

8           establishing a second predetermined number of bits to be used  
9 for random values;

10          causing the devices to select random values, wherein  
11 respective devices choose random values independently of random  
12 values selected by the other devices;

13          transmitting a command from the interrogator requesting  
14 devices having random values within a specified group of random  
15 values to respond, the specified group being less than or equal to  
16 the entire set of random values;

17          receiving the command at multiple devices, the devices  
18 receiving the command respectively determining if the random value  
19 chosen by the command falls within the specified group and, if so,  
20 sending a reply to the interrogator within a randomly selected time  
21 slot of a number of slots; and, if not, not sending a reply; and

22          determining with the interrogator if a collision occurred  
23 between devices that sent a reply and, if so, creating a new,  
24 smaller, specified group.

1 5. A method of addressing messages from an interrogator  
2 to a selected one or more of a number of communications devices  
3 in accordance with claim 4 wherein the sending of a reply to the  
4 interrogator within a randomly selected time slot is in accordance  
5 with an Aloha method.  
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7 6. A method of addressing messages from an interrogator  
8 to a selected one or more of a number of communications devices  
9 in accordance with claim 4 wherein the sending of a reply to the  
10 interrogator within a randomly selected time slot is in accordance  
11 with a slotted Aloha method.  
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13 7. A method of addressing messages from an interrogator  
14 to a selected one or more of a number of communications devices  
15 in accordance with claim 4 wherein the method is an adaptive  
16 method.  
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18 8. A method of addressing messages from an interrogator  
19 to a selected one or more of a number of communications devices  
20 in accordance with claim 4 wherein the number of slots is four.  
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1           9.    A method of addressing messages from an interrogator  
2 to a selected one or more of a number of communications devices  
3 in accordance with claim 4 wherein sending a reply to the  
4 interrogator comprises transmitting the unique identification number  
5 of the device sending the reply.

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7           10. A method of addressing messages from an interrogator  
8 to a selected one or more of a number of communications devices  
9 in accordance with claim 4 wherein sending a reply to the  
10 interrogator comprises transmitting the random value of the device  
11 sending the reply.

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13           11. A method of addressing messages from an interrogator  
14 to a selected one or more of a number of communications devices  
15 in accordance with claim 4 wherein, after receiving a reply without  
16 collision from a device, the interrogator sends a command  
17 individually addressed to that device.

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19           12. A method of addressing messages from an interrogator  
20 to a selected one or more of a number of communications devices  
21 in accordance with claim 4 wherein the time slot randomly selected  
22 by a device is selected using a random number different from the  
23 random value of that device.

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1           13. A method of addressing messages from an interrogator  
2 to a selected one or more of a number of communications devices,  
3 the method comprising:

4           establishing unique identification numbers for respective  
5 devices;

6           causing the devices to select random values, wherein  
7 respective devices choose random values independently of random  
8 values selected by the other devices;

9           transmitting from the interrogator a command requesting  
10 devices having random values within a specified group of random  
11 values to respond, the specified group being less than or equal to  
12 the entire set of random values;

13           receiving the command at multiple devices, the devices  
14 receiving the command respectively determining if the random value  
15 chosen by the device falls within the specified group and, if so,  
16 sending a reply to the interrogator within a randomly selected time  
17 slot of a number of slots; and, if not, not sending a reply; and

18           determining using the interrogator if a collision occurred  
19 between devices that sent a reply and, if so, creating a new,  
20 smaller, specified group.  
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1 14. A method of addressing messages from an interrogator  
2 to a selected one or more of a number of communications devices  
3 in accordance with claim 13 wherein establishing unique  
4 identification numbers for respective devices comprises establishing  
5 a predetermined number of bits to be used for the unique  
6 identification numbers.

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8 15. A method of addressing messages from an interrogator  
9 to a selected one or more of a number of communications devices  
10 in accordance with claim 14 and further including establishing a  
11 predetermined number of bits to be used for the random values.

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13 16. A method of addressing messages from an interrogator  
14 to a selected one or more of a number of communications devices  
15 in accordance with claim 15 wherein the predetermined number of  
16 bits to be used for the random values comprises sixteen bits.

1 17. A method of addressing messages from an interrogator  
2 to a selected one or more of a number of RFID devices, the  
3 method comprising:

4 establishing for respective devices unique identification  
5 numbers respectively having a first predetermined number of bits;

6 establishing a second predetermined number of bits to be used  
7 for random values;

8 causing the devices to select random values, wherein  
9 respective devices choose random values independently of random  
10 values selected by the other devices;

11 transmitting from the interrogator a command requesting  
12 devices having random values within a specified group of random  
13 values to respond, the specified group being less than or equal to  
14 the entire set of random values;

15 receiving the command at multiple devices, the devices  
16 receiving the command respectively determining if the random  
17 values chosen by the device falls within the specified group and,  
18 if so, sending a reply to the interrogator within a randomly  
19 selected time slot of a number of possible time slots, in accordance  
20 with an Aloha method; and, if not, not sending a reply, wherein  
21 sending a reply to the interrogator comprises transmitting both the  
22 random value of the device sending the reply and the unique  
23 identification number of the device sending the reply, and wherein  
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1 the time slot randomly selected by a device is selected using a  
2 random number different from the random value of that device;

3 determining with the interrogator if a collision occurred  
4 between devices that sent a reply and, if so, creating a new,  
5 smaller, specified group; and

6 if a reply without collision is received from a device, the  
7 interrogator subsequently sending a command individually addressed  
8 to that device.

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10 18. A method of addressing messages from an interrogator  
11 to a selected one or more of a number of RFID devices in  
12 accordance with claim 17 wherein the number of possible time slots  
13 is four.

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15 19. A method of addressing messages from an interrogator  
16 to a selected one or more of a number of RFID devices in  
17 accordance with claim 17 wherein the number of possible time slots  
18 is four, wherein the first predetermined number of bits is sixteen,  
19 and wherein the second predetermined number of bits is sixteen.



1           20. A method of addressing messages from an interrogator  
2 to a selected one or more of a number of RFID devices in  
3 accordance with claim 17 wherein the number of possible slots  
4 varies from one specified group to another.

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6           21. A method of addressing messages from an interrogator  
7 to a selected one or more of a number of RFID devices in  
8 accordance with claim 17 and further comprising, after creating a  
9 new, smaller, specified group:

10           the interrogator transmitting a command requesting devices  
11 having random values within a specified group of random values to  
12 respond, the specified group being less than or equal to the entire  
13 set of random values; and

14           devices receiving the command respectively determining if  
15 their chosen random values fall within the new smaller specified  
16 group and, if so, sending a reply to the interrogator within a  
17 randomly selected time slot of a number of possible time slots, in  
18 accordance with an Aloha method.

22. A method of addressing messages from an interrogator to a selected one or more of a number of RFID devices in accordance with claim 21 and further comprising the subsequent steps of the interrogator determining if a collision occurred between devices that sent a reply and, if so, creating a new specified group and repeating the transmitting of the command requesting devices having random values within a specified group of random values to respond using different specified groups until all devices are identified, for every command the devices receiving the command determining if their chosen random values fall within the specified group and, if so, sending a reply to the interrogator within a randomly selected time slot of a number of possible time slots, in accordance with an Aloha method.

1 23. A communications system comprising an interrogator, and  
2 a plurality of wireless identification devices configured to  
3 communicate with the interrogator in a wireless fashion, the  
4 respective wireless identification devices having a unique  
5 identification number, the interrogator being configured to employ  
6 tree search and Aloha techniques to determine the unique  
7 identification numbers of the different wireless identification devices  
8 so as to be able to establish communications between the  
9 interrogator and individual ones of the multiple wireless  
10 identification devices without collision by multiple wireless  
11 identification devices attempting to respond to the interrogator at  
12 the same time.

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14 24. A communications system in accordance with claim 23  
15 wherein the Aloha technique is a slotted Aloha technique.

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17 25. A communications system in accordance with claim 23  
18 wherein the wireless identification device comprises an integrated  
19 circuit including a receiver, a modulator, and a microprocessor in  
20 communication with the receiver and modulator.  
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1        26. A system comprising:  
2        an interrogator;  
3        a number of communications devices capable of wireless  
4        communications with the interrogator;  
5        means for establishing a first predetermined number of bits  
6        to be used as unique identification numbers, and for establishing  
7        for respective devices unique identification numbers respectively  
8        having the first predetermined number of bits;  
9        means for establishing a second predetermined number of bits  
10       to be used for random values;  
11       means for causing the devices to select random values,  
12       wherein respective devices choose random values independently of  
13       random values selected by the other devices;  
14       means for causing the interrogator to transmit a command  
15       requesting devices having random values within a specified group  
16       of random values to respond, the specified group being less than  
17       or equal to the entire set of random values;  
18       means for causing devices receiving the command to determine  
19       if their chosen random values fall within the specified group and,  
20       if so, send a reply to the interrogator within a randomly selected  
21       time slot of a number of slots; and, if not, not send a reply; and  
22       means for causing the interrogator to determine if a collision  
23       occurred between devices that sent a reply and, if so, create a  
24       new, smaller, specified group.

1 27. A system in accordance with claim 26 wherein the  
2 sending of a reply to the interrogator within a randomly selected  
3 time slot is in accordance with an Aloha technique.

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5 28. A system in accordance with claim 26 wherein the  
6 sending of a reply to the interrogator within a randomly selected  
7 time slot is in accordance with a slotted Aloha technique.

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9 29. A system in accordance with claim 26 wherein the  
10 number of slots is four.

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12 30. A system in accordance with claim 26 wherein sending  
13 a reply to the interrogator comprises transmitting the unique  
14 identification number of the device sending the reply.

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16 31. A system in accordance with claim 26 wherein sending  
17 a reply to the interrogator comprises transmitting the random value  
18 of the device sending the reply.

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20 32. A system in accordance with claim 26 wherein sending  
21 a reply to the interrogator comprises transmitting both the random  
22 value of the device sending the reply and the unique identification  
23 number of the device sending the reply.  
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1 33. A system in accordance with claim 26 wherein the  
2 interrogator further includes means for, after receiving a reply  
3 without collision from a device, sending a command individually  
4 addressed to that device.  
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6 34. A system in accordance with claim 26 wherein the time  
7 slot randomly selected by a device is selected using a random  
8 number different from the random value of that device.  
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1 35. A system comprising:

2 an interrogator configured to communicate to a selected one  
3 or more of a number of communications devices;

4 a plurality of communications devices;

5 the devices being configured to select random values, wherein  
6 respective devices choose random values independently of random  
7 values selected by the other devices;

8 the interrogator being configured to transmit a command  
9 requesting devices having random values within a specified group  
10 of random values to respond, the specified group being less than  
11 or equal to the entire set of random values;

12 devices receiving the command being configured to  
13 respectively determine if their chosen random values fall within the  
14 specified group and, if so, send a reply to the interrogator within  
15 a randomly selected time slot of a number of slots; and, if not,  
16 not send a reply; and

17 the interrogator being configured to determine if a collision  
18 occurred between devices that sent a reply and, if so, create a  
19 new, smaller, specified group.

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21 36. A system in accordance with claim 35 wherein the  
22 predetermined number of bits to be used for the random values  
23 comprises sixteen bits.  
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1 37. A system comprising:

2 an interrogator configured to communicate to a selected one  
3 or more of a number of communications devices;

4 a plurality of communications devices, respective devices being  
5 configured to store unique identification numbers respectively having  
6 a first predetermined number of bits, respective devices being  
7 further configured to store a second predetermined number of bits  
8 to be used for random values, respective devices being configured  
9 to select random values independently of random values selected by  
10 the other devices;

11 the interrogator being configured to transmit a command  
12 requesting devices having random values within a specified group  
13 of random values to respond, the specified group being less than  
14 or equal to the entire set of random values;

15 devices receiving the command respectively being configured  
16 to determine if their chosen random values fall within the specified  
17 group and, if so, send a reply to the interrogator within a  
18 randomly selected time slot of a number of possible time slots, in  
19 accordance with an Aloha technique; and, if not, not send a reply,  
20 wherein sending a reply to the interrogator comprises transmitting  
21 both the random value of the device sending the reply and the  
22 unique identification number of the device sending the reply, and  
23 wherein the time slot randomly selected by a device is selected  
24 using a random number different from the random value of that device;



1 the interrogator being configured to determine if a collision  
2 occurred between devices that sent a reply and, if so, create a  
3 new, smaller, specified group; and

4 the interrogator being configured to send a command  
5 individually addressed to a device after communicating with a  
6 device without a collision.

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8 38. A system in accordance with claim 37 wherein the  
9 number of possible time slots is four.

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11 39. A system in accordance with claim 37 wherein the  
12 number of possible time slots is four, wherein the first  
13 predetermined number of bits is sixteen, and wherein the second  
14 predetermined number of bits is sixteen.

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16 40. A system in accordance with claim 37 wherein the  
17 number of possible slots varies from one specified group to  
18 another.